

27. The multi-layer foil of claim 6 wherein the electrically resistive composite material has a resistivity of from about 1 to about 10,000 ohms/square.

*3*  
*cancel*  
*23*  
*28*  
28. The multi-layer foil of claim 6 wherein the non-conductive comprises alumina or boron nitride or both.

29. The multi-layer foil of claim 6 wherein the conductive metal layer comprises copper, the conductive material comprises nickel, and the non-conductive comprises alumina or boron nitride or both.

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Cancel claims 12-20 without prejudice.

#### REMARKS

The examiner has set forth a restriction requirement under 35 U.S.C. 121. Applicants previously provisionally elected Group I, directed to claims 1-11 for examination. Claims 12-20 have been canceled without prejudice and subject to applicant's right to file a divisional application for this subject matter.

The present invention relates to an electrically resistive composite material for printed circuit boards. More particularly, it relates to a durable resistive composite material with improved electrical and thermal dissipative properties. The resistive material of the present invention generally comprises a conductive metal layer having non-conductive particles dispersed throughout. This resistive material can be used in the formation of foils, circuits and the like.

As amended, the claims provide an electrically resistive composite material consists essentially of

(a) an electrically conductive material selected from the group consisting of antimony, arsenic, bismuth, cobalt, tungsten, manganese, lead, chromium, zinc, palladium,

phosphorus, sulfur, carbon, tantalum, aluminum, iron, titanium, chromium, platinum, tin, nickel, silver, copper and combinations thereof, and

(b) an electrically non-conductive particulate material selected from the group consisting of boron nitride, silicon carbide, alumina, silica, platinum oxide, tantalum nitride, talc, polyethylene tetrafluoroethylene, and mixtures thereof evenly dispersed throughout the conductive material.

The examiner has rejected claims 1, 5-7 and 10 under 35 U.S.C. 102 over Castonguay et al. Applicants respectfully assert that this ground of rejection has been overcome by the instant amendment.

Castonguay et al. also relates to printed circuit boards. In particular, it describes a circuit board having a resistive material layer, which layer comprises electroplated nickel alone or together with up to 30 percent by weight of phosphorus.

Applicants respectfully submit that Castonguay et al. fails to teach every aspect of the claimed invention. Applicants amended claims require the presence of non-conductive particles dispersed throughout the conductive metal which are selected from the group consisting of boron nitride, silicon carbide, alumina, silica, platinum oxide, tantalum nitride, talc, polyethylene tetrafluoroethylene, and mixtures thereof. Such is not taught by Castonguay et al and it is submitted that this distinguishes the present invention from Castonguay et al. It is therefore respectfully requested that the 35 U.S.C. 102 rejection be withdrawn.

The examiner has rejected claims 1-4 under 35 U.S.C. 102 over Faber et al. It is submitted that this ground of rejection has also been overcome by the instant amendment. Faber et al teaches an electrically resistant paste comprising a glass frit and a metal oxide, particularly ruthenium oxide and/or iridium oxide, in a vehicle such as ethyl cellulose dissolved in acetone or toluene. It is submitted that Faber et al. fails to teach every aspect of the claimed invention. Faber et al. fails to teach the use of an electrically conductive

material as set forth in the above amended claims. Faber teaches the use of a metal *oxide* but not a metal itself. It is submitted that the absence of this feature of the present invention from the cited reference renders the present invention patentably distinct from Faber et al. It is therefore respectfully requested that the 35 U.S.C. 102 rejection be withdrawn.

The examiner has rejected claims 1-11 under 35 U.S.C. 102 over Endo. Applicants wish to point out that the examiner has cited figures, tables, and columns which do not appear in Endo. Applicants believe that the examiner is referring to U.S. Pat. No. 3,669,907 to Kohashi et al. Applicants will argue against both of these references.

Endo teaches an electrical conductor which comprises a mixture of a resin and a conductive powder. Endo fails to teach an electrically non-conductive particulate material selected from the group consisting of boron nitride, silicon carbide, alumina, silica, platinum oxide, tantalum nitride, talc, polyethylene tetrafluoroethylene, and mixtures thereof. It is therefore respectfully requested that the 35 U.S.C. 102 rejection be withdrawn.

Kohashi et al. teaches a mixture of a vitreous binding material and a semiconductive metal oxide powder. This reference fails to teach a resistive material having a conductive material consisting essentially of an electrically conductive material with non-conductive particles dispersed throughout, which is a key feature of the present invention. There is no mention of an electrically conductive material selected from the group consisting of antimony, arsenic, bismuth, cobalt, tungsten, manganese, lead, chromium, zinc, palladium, phosphorus, sulfur, carbon, tantalum, aluminum, iron, titanium, chromium, platinum, tin, nickel, silver, copper and combinations thereof. It is submitted that the absence of this feature of the present invention from the cited reference renders the present invention patentably distinct from Kohashi et al.

The examiner has rejected claims 1-11 under 35 U.S.C. 102 over Ambros et al. It is submitted that this ground of rejection has been overcome by the above amendment. Ambros et al. teaches a layer of resistor paste which comprises a melamine-formaldehyde binder and a filler of conductive particles and/or pyropolymers. Applicants respectfully submit that Ambros et al. fails to teach every aspect of the claimed invention. Ambros et al. fails to teach a resistive material having the above grouping of conductive material together with the claimed grouping of non-conductive particles dispersed throughout, which is a key feature is a key feature of the present invention. It is submitted that the absence of this feature of the present invention from the cited reference renders the present invention patentably distinct from Ambros et al. It is therefore respectfully requested that the 35 U.S.C. 102 rejection be withdrawn.

The examiner has rejected claims 1, 6, and 8-9 under 35 U.S.C. 102 over Yamada et al. Applicants respectfully urge that this rejection should be withdrawn. Yamada et al. relates to a conductive polymer composition. More particularly, it teaches a composition which includes a crystalline polymer and large particles of carbon black.

Applicants assert that Yamada et al. also fails to teach every aspect of the claimed invention. Yamada requires 100 parts by weight of a crystalline polymer and 40-150 parts by weight of carbon black. The examiner has conceded Yamada et al. fails to teach an electrically conductive material selected from the group consisting of antimony, arsenic, bismuth, cobalt, tungsten, manganese, lead, chromium, zinc, palladium, phosphorus, sulfur, carbon, tantalum, aluminum, iron, titanium, chromium, platinum, tin, nickel, silver, copper and combinations thereof. Thus, it is submitted that the absence of this feature of the present invention from the cited reference renders the present invention patentably distinct from Yamada et al. Applicants therefore respectfully request that the 35 U.S.C. 102 rejection be withdrawn.

The examiner has rejected claims 10-11 under 35 U.S.C. 103 over Yamada et al. in view of Chandler et al. The examiner asserts that it would have been obvious for one skilled in

the art to combine these references to produce the presently claimed invention.

Applicants respectfully urge that this is not the case.

As stated above, Yamada et al. teaches a composition which includes a 100 parts by weight of a crystalline polymer and 40-150 parts by weight of large particles of carbon black. As one can see, such is distinctly different from the amended claims. The examiner has noted that Yamada et al. fails to teach a conductive filler being metal, as is taught by the present invention.

Chandler et al. is cited for teaching the use of a metal rather than carbon black. However, the combination of Yamada et al and Chandler et al still requires 100 parts by weight of a crystalline polymer. The combination of these references still fails to teach a material consisting essentially of an electrically conductive material selected from the group consisting of antimony, arsenic, bismuth, cobalt, tungsten, manganese, lead, chromium, zinc, palladium, phosphorus, sulfur, carbon, tantalum, aluminum, iron, titanium, chromium, platinum, tin, nickel, silver, copper and combinations thereof, and [a] an electrically non-conductive particulate material selected from the group consisting of boron nitride, silicon carbide, alumina, silica, platinum oxide, tantalum nitride, talc, polyethylene tetrafluoroethylene, and mixtures thereof evenly dispersed throughout the conductive material. Likewise it does not suggest a multi-layer foil comprising a copper metal layer having a shiny surface, and an electrically resistive composite material layer associated with the copper metal layer shiny surface wherein the electrically resistive composite material layer includes from about 0.01 to about 99.9 area % of a conductive metal other than copper and from about 0.01 to about 99.9 area % of particles of a non-conductive material selected from alumina, boron nitride, and mixtures thereof.


It is submitted that one skilled in the art would not be imbued with an inspiration to form the present invention upon a combined reading of Yamada et al. and Chandler et al.

Applicants therefore respectfully request that the 35 U.S.C. 103 rejection be withdrawn.

The enclosed Information Disclosure Statement presents references cited by the PCT examiner and lists the Kohashi, et al reference.

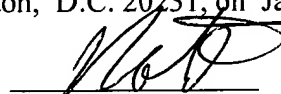
The undersigned respectfully requests re-examination of this application and believes it is now in condition for allowance. Such action is requested. If the examiner believes there is any matter which prevents allowance of the present application, it is requested that the undersigned be contacted to arrange for an interview which may expedite prosecution.

Respectfully submitted,



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I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail, postage pre-paid in an envelope addressed to Assistant Commissioner for Patents, Washington, D.C. 20231, on January 15, 2000.



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